CARBON MEMBRANES DERIVED FROM POLYMER BLEND OF POLYETHERIMIDE AND POLYETHYLENE GLYCOL FOR GAS SEPARATION

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by

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LIST OF ABBREVIATIONS

6FDA	2,2'-bis(3,4-dicarboxyphenyl) hexafluoropropane dianhydride
AFM	Atomic force microscopy
APB	1,3-Bis(3-aminophenoxy) benzene
BET	Brunauer-Emmet-Teller
BJH	Barrett-Joyner-Halenda
BPDA	Biphenyltetracarboxylic dianhydride
BTDA	Benzophenone tetracarboxylic dianhydride
CA	Cellulose acetate
CM	Carbon membrane
DAM	Diamino mesitylene
DDBT	Dimethyldibenzothiophene sulfone
FA	Furfuryl alcohol
FFV	Fractional free volume
HCN	Hydrogen cyanide
HFCM	Hollow fiber carbon membrane
H-K	Horvath-Kawazoe
IUPAC	International Union of Pure and Applied Chemistry
MFI	Mordenite framework inverted
MMSCFD	Million metric standard cubic feet per day
MSD	Micropore size distribution
MWNT	Multi-walled carbon nanotube

NDA	Naphthalene dicarboxylic acid
NMP	N-methyl-2-pyrrolidone
NPC	Nanoporous carbon
ODA	Oxydianiline
PAN	Polyacrylonitrile
PEG	Polyethylene glycol
PEI	Polyetherimide
PFA	Polyfurfuryl alcohol
PFNR	Phenol formaldehyde novolac resin
PFR	Phenol formaldehyde resin
PI	Polyimide
PPES	poly(phthalazinone ether sulfone)
PPESK	poly(phthalazinone ether sulfone ketone)
PPM	Partially pyrolyzed membrane
PPO	Poly(phenylene oxide)
PPy	Polypyrrole
PR	Phenolic resin
PSA	Pressure swing adsorption
PSD	Pore size distribution
PVB	Poly(vinylbutyral)
PVDC-AC	Polyvinylidene chloride-acrylate terpolymer
PVDC-PVC	Poly(vinylidene chloride)-polyvinyl chloride
PVP	Polyvinylpyrrolidone
RFR	Resorcinol-formaldehyde resin

RF	Resin formaldehyde
SEM	Scanning electron microscopy
SPAEK	Sulfonated poly(aryl ether ketone)
Tg	Glass transition temperature
TGA	Thermal gravimetric analysis
TMS	Trimethylsilyl
TrisAPB	tris-1,3-Bis(3-aminophenoxy) benzene
TSA	Thermal swing adsorption
XRD	X-ray diffraction

LIST OF SYMBOLS

		Unit
A	Membrane area	cm^2
Ag	Silver	-
Al_2O_3	Alumina	-
Ar	Argon	-
A_0	Cross-sectional area of the pore	cm^2
A_i	Cross-sectional area of the pore	cm^2
b	Equilibrium adsorption constant	Pa^{-1}
C	Carbon	-
C_3H_6	Propene	-
C_3H_8	Propane	-
CH_4	Methane	-
CO	Carbon monoxide	-
CO_2	Carbon dioxide	-
D	Diffusion coefficient	$m^2\ s^{-1}$
d	Dimension spacing	nm
d_{eff}	Effective diffusion space	nm
d_k	Diameter of permeating gas	nm
d_p	Pore diameter	nm
dc/dx	Concentration gradient of the gas across the membrane	$mol\ m^{-4}$
E_a	Apparent activation energy	kJ/mol

f_P	Normalized gas permeability	-
H	Hydrogen	-
H_2	Hydrogen gas	-
l	Thickness of the membrane material	cm
J	Flux of gas through the membrane	mol m^{-2} s^{-1}
M	Molecular weight of the gas	g/mol
N	Nitrogen	-
N_2	Nitrogen gas	-
N_p	Number of pores	-
n	Integral number	-
NH_3	Ammonia	-
NO_x	Nitrogen oxides	-
O	Oxygen	-
O_2	Oxygen gas	-
P	Permeability	barrer
P/l	Permeance	GPU
p	Pressure	Pa
p_{feed}	Pressure at feed stream	cmHg
Q	Volumetric flow rate of gas at standard temperature and pressure	cm^3/s
R	Gas constant	J K^{-1} mol^{-1}
T	Absolute temperature	K
t	Time	s
V	Volume of permeate gas	cm^3